

### Natural Selection Background

2 definitions of evolution

1. descent with modification
2. change in the genetic composition of a population from generation to generation

**natural selection:** individuals with certain inherited traits tend to survive and reproduce more than others because of those traits

**artificial selection:** breeding to encourage the occurrence of desirable traits

\*individuals don't evolve, *populations evolve*

\*natural selection only works on traits that differ in individuals

\*environmental factors change, so favorable traits change

### Important People

#### 1. Linnaeus

- made the format of naming species

#### 2. Cuvier

- *catastrophism*: catastrophes cause changes in species

#### 3. Hutton

- Earth's geological features due to mechanisms still around today (ex. rock cycle)

#### 4. Lyell

- *uniformitarianism*: same processes occurring today also happened in the past

#### 5. Lamarck

- *use and disuse*: parts of the body used become more advanced and those not used deteriorate

- *inheritance of acquired traits* = organisms pass modifications to offspring

#### 6. Darwin

- development of the theory of *natural selection*

### Darwin's Evidence for Evolution

#### 1. homology

↳ similarity in characteristics resulting from a shared ancestry

- *homologous structures*: structures in different species that are similar (structurally) because of common ancestry

- *vestigial structure*: feature of an organism that is a historical remnant of one once used

### Darwin's Evidence for Evolution (cont)

#### 2. embryology

↳ structures present in embryos can explain the similarities in different species

- *convergent evolution*: similar features in independent evolutionary lineages

- *analogous structures*: characteristics that are similar because of convergent evolution

#### 3. fossils

- indicate structural similarities between different species

- document formation of new species

#### 4. biogeography

↳ study of the past and present geographic distribution of species

#### 5. artificial selection

### Allele Frequency

3 MECHANISMS THAT CHANGE ALLELE FREQUENCY

#### 1. Natural Selection

↳ improves the match between organism and the environment

#### 2. Genetic Drift

↳ chance events alter allele frequencies

↳ *founder effect*~ few individuals isolated from the larger population & establish a new population

↳ *bottleneck effect*~ population is reduced by natural disasters/human actions

#### 3. Gene Flow

↳ transfer of alleles between populations (from migration & mating)

**genetic variation:** differences in individuals composition of their genes/DNA segments (ex. mutations)

↳ in sexual reproduction= *crossing over*; *independent assortment*; *fertilization*

**geographic variation:** differences in the gene pools of geographically separate populations

↳ *cline*~ graded change in a character along a geographic axis

(<sup>^</sup> *microevolution* <sup>^</sup>)

### Hardy-Weinberg

**Hardy-Weinberg principle:** frequencies of alleles and genotypes remain constant for each generation

### Hardy-Weinberg (cont)

↳ Hardy-Weinberg equilibrium predicts the allele frequencies in a nonevolving population

#### 5 Conditions

1. NO Mutations
2. Random Mating
3. NO Natural Selection
4. Large Population Size
5. No Gene Flow

\* if one not present --- genes evolving

(<sup>^</sup> microevolution <sup>^</sup>)

### Hardy-Weinberg Equations

$$p + q = 1$$

p = Frequency of dominant allele (A)  
q = Frequency of recessive allele (a)

$$p^2 + 2pq + q^2 = 1$$

(Frequency of AA) (Frequency of Aa) (Frequency of aa)

### Selection

**relative fitness:** contribution an individual makes to the gene pool in relation to their ability to survive in their environment

#### 3 MODES OF SELECTION

1. **Directional selection** favors 1 extreme/side
2. **Disruptive selection** favors both extremes/sides
3. **Stabilizing selection** favors intermediate

#### Sexual Selection

- sexual selection:** individuals with certain characteristics are more likely to obtain a mate
- sexual dimorphism:** differences between secondary sex characteristics of males and females
- intrasexual selection:** competition among individuals of 1 sex for mates
- intersexual selection:** 1 sex choosy in selecting their mates of the other sex
- heterozygote advantage:** better reproductive success of heterozygotes (preserve variation)

(<sup>^</sup> microevolution <sup>^</sup>)

C

By **kmz\_2022**  
[cheatography.com/kmz-2022/](https://www.cheatography.com/kmz-2022/)

Not published yet.  
Last updated 10th May, 2022.  
Page 2 of 5.

Sponsored by **Readable.com**  
Measure your website readability!  
<https://readable.com>

### Speciation

<b>adaptive radiation</b>	period in which organisms form many new species whose adaptations have them fill different niches
<b>punctuated equilibrium</b>	long periods which a species undergoes little change interrupted by brief periods of sudden change
<b>reproductive isolation:</b>	biological factors that impede members of 2 species from producing viable, fertile offspring
<b>postzygotic barrier:</b>	reproductive barrier that prevents hybrid zygotes from developing
<b>hybrid:</b>	offspring resulting from the mating of 2 different species
<b>prezygotic barrier:</b>	reproductive barrier that hinders the fertilization between species

#### PREZYGOTIC BARRIERS

<b>1. Habitat isolation</b>	different habitats then they never interact
<b>2. Temporal isolation</b>	breed at different times of the day/seasons/years
<b>3. Behavioral isolation</b>	courtship rituals differ
<b>4. Mechanical isolation</b>	morphological differences
<b>5. Gamete isolation</b>	sperm can't fertilize egg

#### POSTZYGOTIC BARRIERS

<b>1. Reduced hybrid viability</b>	genes of parents impair hybrid development/survival
<b>2. Reduced hybrid fertility</b>	hybrid sterile due to chromosomes from parents
<b>3. Hybrid breakdown</b>	when hybrids mate, offspring are feeble/sterile

#### Species Concepts

<b>a. morphological</b>	by body shape/structural features
<b>b. ecological</b>	by ecological niche
<b>c. phylogenetic</b>	smallest group that share a common ancestor
<b>d. *biological*</b>	by inbreeding of members

### Speciation (cont)

↳ limitations: designates absence of gene flow & doesn't apply to asexual organisms

#### Speciation Types

**a. allopatric speciation** when a species is geographically isolated from original population

↳ geographic separation → mutations → reproductive isolation → speciation

**b. sympatric speciation** when a species is isolated with NO geographic isolation

↳ ex). disruptive selection; polyploidy; lateral transfer

**c. parapatric speciation** when species interbreed over a geographic continuum

↳ ex). clines- elevation change

(^ *macroevolution* ^)

### Phylogeny

**phylogeny** evolutionary history of a species/group of organisms

**phylogenetic tree** branching diagram representing the evolutionary history of organisms

**taxonomy** naming and classifying forms of life

**taxon** taxonomic unit at any given level of classification

**cladistics** organisms are placed into groups called clades based on common descent

**clade** groups of species that includes an ancestral species & ALL its descents

**monophyletic group** a common ancestor & ALL its descendants

**paraphyletic group** a common ancestor & SOME of its descendants

**polyphyletic group** derived from 2+ different ancestors

**outgroup** group that is least closely related to the other organisms

**ancestral character** character shared by members of a certain clade originated in an ancestor not a member of the clade

**derived character** character that is new/unique to a certain clade

### Phylogenetic Tree vs. Cladogram



\* represent hypotheses

### Binomial Nomenclature

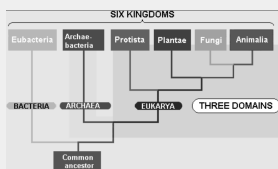
- made by: *Linnaeus*
- two parts: genus & species
- rules: first word capitalized, second lowercase  
all italicized/underlined

### 8 LEVELS OF CLASSIFICATION

(Dear King Philip Came Over For Good Soup)

Domain → Kingdom → Phylum → Class → Order → Family → Genus → Species

### Kingdoms & Domains



- \* protista kingdom not really considered (closely related to the other eukarya kingdoms)
- \* evidence of common ancestry of all eukaryotes = *membrane-bound organelles, linear chromosomes, & introns*

### Prokaryotes Information

(bacteria, archaea, & protists)

- capsule/slime layer** protects against dehydration/shield against immune system
- fimbriae** hair like appendages used to attach to host
- pilli** appendages that pull 2 cells together
- nucleoid** region in a prokaryotic cell where DNA is located
- positive chemotaxis** movement TOWARDS nutrients/oxygen
- negative chemotaxis** movement AWAY from a toxic substance
- endospore** can survive in harsh/insufficient environments (dormant but viable)

### POPULATION GROWTH

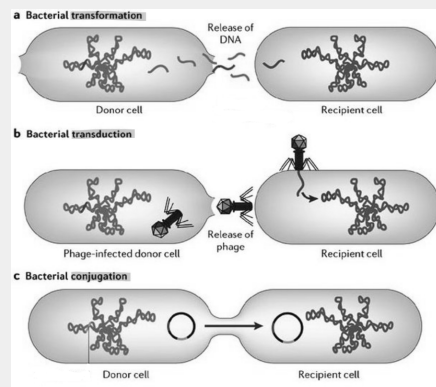
### Prokaryotes Information (cont)

- in ideal lab conditions = 20 minutes
- typical human intestines = 12-24 hours

#### 4 Limitations

1. *exhaust* nutrient supply
2. *poison* themselves with metabolic wastes
3. *competition* from other microorganisms
4. *consumed* by other organisms

### Bacterial DNA Transfer Types



**transformation:** assimilation of external DNA

**transduction:** viruses carry bacterial DNA from one cell to another

**conjugation:** direct transfer of DNA

### Endosymbiosis

#### Mitochondria~

- first eukaryotes acquired mitochondria by engulfing an aerobic prokaryote

↳ evidence: DNA data & found in all eukaryotes

#### Plasids~

- eukaryotes acquired photosynthetic bacterium that evolved into plastids

↳ evidence: plastid and photosynthetic bacterium genes closely resemble

**secondary endosymbiosis** process in which a eukaryotic cell engulfed a photosynthetic eukaryotic cell

### Early Earth

**- Miller & Urey experiment:** demonstrated how the atmosphere could spontaneously produce organic molecules

↳ other possible source of organic molecules: *volcanoes or deep-sea vents*

**protocell** abiotic precursor of a living cell that had an internal chemistry different from its surroundings

↳ created spontaneously when *lipids are added to water*

**\*RNA World** life on Earth began with an RNA molecule that could copy itself

↳ **ribozymes**~ enzyme that makes copies of RNA

### EVENTS

1. earth formation

2. stromatolites/oldest cells (unicellular)

3. photosynthetic bacteria (releases O<sub>2</sub>)

4. aerobic respiration

5. eukaryotic organisms

6. sexual reproduction

7. multicellular/terrestrial algae

\* more O<sub>2</sub> in atmosphere helps ozone protect against radiation

**Cambrian explosion** brief time in history when there was an explosion of land & water diversity

↳ claws & defensive adaptation become present

mass extinction causes... volcanic eruptions; asteroids/comets; human actions

### Fossils

FOSSILIZATION	RATES
HIGH	LOW
- existed a long time	- existed a short time
- abundant/widespread	- not abundant
- hard shells/skeleton	- soft/no shell/ no skeleton
- sedimentary rock	- not in sediments
<b>radiometric dating</b>	method to determine absolute age based on half-life
- isotope used:	carbon 14 (becomes nitrogen 14)

